VIII. Recognition and Management of Malnutrition

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Malnutrition

Goals and Objectives

Participants will demonstrate the achievement of the following objectives through both written and practical exam.

1. Participants will understand the **general concepts and terminology** used in feeding programs in the developing world.

    - Define General food program (GFP), Supplemental food program (SFP), and Therapeutic food program (TFP)
    - Describe the types of rations typically used as food aid: wet rations (MRE, HDR…), dry rations and their nutritional content
    - Understand the epidemiology, recognize the clinical manifestations and indicate the appropriate treatment of marasmus, kwashiokor, and the most common micro nutrient deficiencies in the humanitarian emergency setting
    - Vitamin A, Fe, B, and C vitamins
    - Recognize the importance and limitations of nutritional assessments (surveys) of anthropometric measurements in shaping feeding programs for populations
    - Define weight/height, Z scores and MUAC
    - Define a random and cluster survey
    - Differentiate cross sectional and longitudinal surveys
    - Understand the effects of sample bias, out-migration, co-morbid disease and other factors on the interpretation of simple surveys
    - Understand the importance of integration of local culture and local human resources into individual and population based feeding programs

2. Participants will be able to **assess and treat an individual** with nutritional deficiencies.

    - Characterize a patient's overall caloric nutritional status and identify the presence of a key micro nutrient deficiency through physical examination and the proper collection and interpretation of appropriate anthropometric measurements (WT/HT, MUAC)
    - Design an appropriate treatment plan for a malnourished patient in a scenario with defined but limited resources

3. Participants will be able to **assess the nutritional status of a population through sampling and implement an appropriate small scale-feeding program.**
    - Suggest a way to characterize the nutritional status of a population through a random cross sectional survey given a scenario
    - Design an appropriate feeding program for a given population with available resources including defining a target population, nutritional goals, means of monitoring efficacy and treatment endpoints.

4. Participants will understand the importance of **promoting breast-feeding** in emergency situations.
   - Understand the importance of providing supplemental feeding to breast feeding mothers
   - Understand the limited role for breast milk substitutes in emergency settings in the developing world.

Nutritional Management of Individuals in Humanitarian Circumstances

I. Anthropometrics – ways to quantify the severity of the nutritional situation to allow planning and implementation of an appropriate response

A. Weight for height or length % median **(W/H)**

1. Definition: the child's weight expressed as a percentage of the median weight of children of the same height; an individual's height and weight are compared with those of a reference population.
2. Interpretation: Weight for length (height) percent of median curves and tables based on NCHS/WHO unisex reference population (Table 2)
   a) <70% W/H – severe malnutrition; send to therapeutic feeding program (TFP)
   b) 70-79% W/H – moderate malnutrition; send to supplementary feeding program (SFP)

B. **Z score** - expresses a child's weight as a multiple of the standard deviation of the reference population; statistically more correct than weight for height (Table 3)

C. **Mid upper arm circumference (MUAC)** - used to screen large numbers of children for possible malnutrition

1. Technique: Measure MUAC on the left arm. Find the midpoint of the upper arm and wrap the tape around the arm without pulling too tightly or leaving too loose. Read the measurement to the nearest 0.1 cm. (Figure 1)
2. Interpretation (Figure 2)
   a) Gives larger estimates of the percentage of children who are malnourished compared with weight for height.
   b) Used in children 6 mos-5 years old
      <13.5 cm MUAC -- refer for weight and height measurement or send to SFP
      < 12 cm MUAC -- send to TFP

D. **Body mass index (BMI)** - weight in kilograms divided by height in meters squared (Table 4)

1. Used in adults and adolescents
2. Reflects acute or short-term malnutrition

Nutritional status	W/H Z-score	W/H % median	MUAC
Moderate acute malnutrition	Between –3 and -2 standard deviations	Between 70% of median and less than 80%	Between 110 mm and less than 125 mm
Severe acute malnutrition	Less than –3 standard deviations or edema	Less than 70% of median or edema	Less than 110 mm or edema
Global acute malnutrition	Less than –2 standard deviations or edema	Less than 80% of median or edema	Less than 125 mm or edema

TABLE 1: The cutoff points most commonly used to define acute malnutrition for different indicators standardized by the NCHS/WHO conference (from Medecins Sans Frontieres. *Nutritional Guidelines.* 1995.)

II. Protein energy malnutrition

A. **Protein energy malnutrition (PEM)** is a general term describing a multiple nutritional deficiency state. It focuses less on specific causality than do the historic terms marasmus and kwashiorkor, recognizing that in the majority of cases, clinical malnutrition in children results from a combination of energy and protein deficiency and may be complicated by micronutrient deficiency.

B. Classic terminology: the importance of familiarity with these terms is to recognize the different patterns of clinical presentation of malnutrition in children.

1. **Marasmus** -- severe deprivation of energy and protein, resulting in severe weight reduction, muscle and subcutaneous tissue wasting, marked stunting, apathy and irritability. (Figure 3)
   a) Most common in infants under 1 year of age
   b) Hungry
   c) Profound emaciation
2. **Kwashiorkor** -- results from inadequate protein intake and/or the catabolic stress of infection. Infection may stress a stable patient with

marasmus to develop kwashiorkor. It is characterized by edema, flaking skin lesions, hair changes, hepatomegaly. (Figure 4)

a) Most common in children 1-3 years of age

b) Anorexic, difficult to feed

c) Impaired immunity, prolonged hospitalizations

d) Edema may falsely imply more adequate nutritional state

3. Marasmic kwashiorkor – mixed type of undernutrition with edema, gross wasting, stunting, and mild hepatomegaly

III. Micronutrient deficiencies -- seen commonly in conjunction with PEM

A. Steps to take when micronutrient deficiency is identified

1. Provide individual treatment and secondary prevention for the identified cases.

2. Population approach if deficiency diseases are prevalent on a large scale.

a) Advocate change in general ration composition and quantities.

b) Consider food fortification: cost, technical possibilities.

c) Stimulate garden projects.

d) Mass supplementation of the population with vitamin tablets.

e) Vitamin supplementation outreach campaigns through health service activities (feeding centers, vaccination programs).

f) Monitor the extent and trends of disease.

B. Specific micronutrient deficiencies (Table 5)

1. Vitamin A

Deficiency: xerophthalmia

a) Predisposing diet: no/few fresh fruits; low dietary fat

b) Solutions: dark orange fruits and vegetables (mango, papaya, orange sweet potatoes, squash), yellow corn, fortified cereal blends, animal products, red palm oil, dark green leafy vegetables

c) Clinical manifestations: night blindness; conjunctival xerosis; Bitots spots (foamy patches at sides of eye); corneal xerosis (clouding) and ulceration; keratomalacia (cornea bursts resulting in blindness); poor growth; impaired resistance to infection; vitamin

A stores rapidly depleted by measles; measles more severe in children with vitamin A deficiency

d) Treatment

1) Supplementation

6-12 months 100,000 IU po every 3-6 months

1-6 years 200,000 IU po every 3-6 months

lactating mothers 200,000 IU at delivery or within 2 mos

2) Xerophthalmia in children > 1 year or adult males: 200,000 IU po on diagnosis; repeat the following day and 4 weeks later (note: halve doses for children < 1 year or < 8 kg)

3) Women of reproductive age with night blindness, Bitots spots: 10,000 IU po daily for 2 weeks

4) Children with complicated measles: 200,000 IU po day 1, 20,000 IU po day 2

2. Vitamin B1 (thiamine)

Deficiency: beri-beri

a) Predisposing diet: polished rice

b) Solutions: parboiled rice, whole grains, groundnut, legumes, meat, fish, milk, eggs, fortified cereal blends

c) Clinical manifestations: early – fatigue, anorexia, abdominal discomfort

1) "dry" beri-beri – bilateral peripheral polyneuritis with evolution to flaccid paralysis

2) "wet" beri-beri – cardiovascular syndrome with edema and heart failure, sudden death

d) Treatment

1) Supplementation: dietary fortification

2) Deficiency: Thiamine 50 mg on diagnosis, then 10 mg/day until recovery

3. Vitamin B2 (riboflavin)

a) Predisposing diet: few animal products

b) Solutions: meat, eggs, fish, animal milk, leafy green vegetables

c) Clinical manifestations: angular stomatitis, glossitis, corneal vascularization

d) Treatment: supplement with foods – RDA 0.6 mg/1000 kcal

4. Vitamin B3 (niacin)

Deficiency: pellagra

a) Predisposing diet: maize-based diet, low protein diet

b) Solutions: nuts, beans, whole grain cereals, meat, fish, eggs, milk, fortification

c) Clinical manifestations: diarrhea, dementia, dermatitis (dark, dry skin lesions in sun-exposed areas)

d) Treatment

1) Supplementation: dietary fortification

2) Deficiency: Niacin 50-100 mg po daily until skin lesions recover

5. Vitamin B6 (pyridoxine)

a) Predisposition: INH is a pyridoxine antagonist

b) Solutions: liver, meat, whole grains, corn, soy beans

c) Clinical manifestations: dermatitis, glossitis, cheilosis, peripheral neuritis

Infants: irritability, convulsions, anemia

d) Treatment: RDA infants 0.2-0.3 mg/d; adults 2 mg/d

6. Vitamin C (ascorbic acid)

Deficiency: scurvy

a) Predisposing diet: no/few fresh fruits and vegetables

b) Solutions: onions, cabbage, peppers, oranges, tomatoes, liver, fresh animal milk

c) Clinical manifestations: swollen, bleeding gums with loss of teeth; swollen, painful joints; internal hemorrhage

7. Vitamin D

Deficiency: rickets

a) Predisposition: little sunlight

b) Solutions: fortified animal milk, liver, egg yolk

c) Clinical manifestations: rickets, osteomalacia

d) Treatment: 400 IU po per day

8. Iron

Deficiency: anemia

a) Predisposition: few animal products in diet; parasitic infections

b) Solutions: animal products (liver, meat); dried fruit; green vegetables; vitamin C to enhance bioavailability of iron; iron and folate supplements

c) Clinical manifestations: fatigue, pallor, increased susceptibility to infection and lead poisoning; reduced learning and work capacity

d) Treatment: (children) 50 mg/day for each year of age

9. Iodine

a) Predisposition: food grown in isolated, inland areas where soil is deficient in iodine; cabbage and cassava interfere with availability of iodine to thyroid

b) Solutions: animal products, marine fish

c) Clinical manifestations: goiter, reproductive failure; cretinism in children born to mothers deficient in iodine

d) Treatment: 150 mg daily; dietary supplementation

10. Zinc

a) Predisposition: few animal products

b) Solutions: liver, meat, fortified cereal blends

c) Clinical manifestations: scaling, plaque-like dermatitis; alopecia; glossitis; nail dystrophy; lethargy; anorexia

d) Treatment: 15 mg daily; dietary fortification

IV. **Infant feeding**: importance of **breastfeeding** promotion

A. Emergency or crisis situations result in circumstances in which bottle feeding can be **life-threatening** to the infant.
   1. Higher infection loads
   2. Contamination of water supply
   3. Lack of fuel for formula preparation
   4. Disruption of the supply of commercial formula products

B. Benefits of breastfeeding
   1. Nutritional and immunologic advantages established
   2. Maintain essentially normal infant growth in emergency circumstances
   3 Promote bonding and care between mother and child
   4. Improve maternal sense of competence, empowerment, self esteem and stress reduction
   5. Conserve scarce food resources within a household
   6. Contributes to sustainable development and food security

C. Correction of misconceptions about breastfeeding in emergencies
   1. Women can breastfeed under stressful conditions
      a) Milk production is adequate under stress
      b) Milk release may be affected by stress
         1) Suckling stimulates oxytocin release and thereby milk release
         2) Emotional, social and technical support for breastfeeding women in emergency situations is essential
   2. **Malnourished women produce enough breast milk -- quality and quantity.**
      a) Supplement the mother, not the infant.
      b) Supplementing the infant decreases suckling and milk production.

D. Optimal infant feeding practices in emergencies
   1. **Initiate breast feeding** within one hour of birth
   2. Frequent, **on-demand feeding**, including night feeds
   3. **Exclusive breastfeeding** until 6 months of age

4. Complement breastfeeding with appropriate foods at about 6 months. **Weaning foods should be calorie-dense and micronutrient-rich.** Porridges and premixes eventually are replaced by local foods.
5. **Sustain breastfeeding until 24 months of age**
6. Increase breastfeeding frequency and continue feeding calorie-dense weaning foods during illness and for catch-up during recovery.
7. **Even women at risk for HIV infection** due to high prevalence should breastfeed. The known and potential benefits of breastfeeding together with the risks of alternatives in developing countries outweigh the relatively low risk of transmission of HIV through breastfeeding.
8. Do not employ relief policies and services that undermine breastfeeding (bottles, artificial nipples)
9. **Training and support for relief workers** with specific guidelines
10. **Breastfeeding counselors** – breastfeeding mothers need help to ensure optimal breastfeeding
11. **Supplement the lactating mother** and address fears of breastmilk insufficiency due to diet quantity or quality
12. Attempt **relactation** if infant < 6 mos
13. If mother dead or absent, consider **wet nursing or milk banking**

E. Breast milk substitutes: an emergency should not become a new market for formula manufacturers

1. Used in special circumstances such as orphans
2. Used in controlled conditions such as on-site feeding, not for general distribution.
3. Accompany with additional health care, water, fuel, and ORT for diarrhea
4. Initiate only if supply is guaranteed as long as needed.
5. Plan for reestablishment of breastfeeding.
6. Sweetened condensed milk and dried skim milk are not appropriate.

V. Feeding the malnourished

A. Definitions

1. **Therapeutic feeding program (TFP)**: a complete regimen targeted to provide a carefully balanced and intensively managed dietary regimen accompanied by medical intervention to rehabilitate a severely malnourished child.
2. **Supplementary feeding program (SFP)**: adds foods and nutrients to an existing diet. The program may be non-targeted or targeted to vulnerable and special groups such as women and children, workers, etc.
3. **General food plan (GFP)**: provides a complete ration of energy, protein and micronutrients to all members of a population.

B. Selection criteria for participation in feeding programs (Figure 5)

1. Anthropometric surveys
2. Program objectives, available resources
3. Targeting vulnerable population
    a) Location
    b) Age (less than 2 years is a priority), sex
    c) Baseline nutritional status
    d) Food intake
    e) Health criteria (pregnant, lactating)
    f) Others: elderly, disabled, twins, TB, AIDS

C. Caution in nutritional therapy: **the refeeding syndrome**

1. Definition: the metabolic and physiologic consequences of the depletion, repletion, compartmental shifts and interrelationships of phosphorus, potassium, magnesium, sodium, glucose and fluid.
2. In starvation, there is depletion of muscle mass, water, minerals, and electrolytes. Serum concentrations preserved by adjusting renal excretion rates.
3. With refeeding, there is intracellular uptake of glucose, phosphorus, water, other electrolytes.
    a) Hypophosphatemia results, as well as depletion of other metabolically important phosphorylated compounds: ATP, 2,3-DPG.

b) Abnormalities of cardiac, hematologic, respiratory, neuromuscular, hepatic and skeletal systems ensue.

c) Circulatory overload may also result from fluid and electrolyte shifts.

D. **Therapeutic feeding program**

1. **Severe malnutrition** (<70% W/H, -3 Z scores)
2. Resources available to combine nutritional and medical components
3. Two phases (TABLE 6)
   a) Phase 1: Rehydration, commencement of medical treatment, initiation of nutritional treatment
   b) Phase 2: Continuation of medical treatment, nutritional rehabilitation, transition to social environment

Care	Actions
FIRST PHASE: 24 hour care	1-7 days
- Rehydration	Special formulation
- Start medical treatment	Systematic + prescribed
- Initiation nutritional treatment	8-10 feeds/day; 100 Kcals/kg/day
SECOND PHASE: day-care	+/- 14 days*
- Continuation medical treatment	Systematic + prescribed
- Nutritional rehabilitation	4-6 feeds/day; to > 200 Kcals/kg/day
- Transition to social environment	Vary diet, psychosocial stimulation

* The length of time a child spends in Phase 1 should be limited to less than 7 days as the diet provided does not allow nutritional rehabilitation. The length of time in phase 2 depends upon the rate of recovery.

TABLE 6: Treatment Phases of Severe Malnutrition: TFP (from Medecins Sans Frontieres. *Nutritional Guidelines.* 1995.)

4. Emergency TFP
    a) Mother primary caregiver
    b) Importance of breastfeeding: promote and continue during therapy
5. Medical treatment addresses the **main causes of death** in severe malnutrition
    a) Dehydration
        1) IV fluids only in cases of severe shock
        2) IV fluids carry significant risk of circulatory overload
        3) Electrolyte imbalances in PEM: sodium excess, potassium and magnesium deficiency. For severe malnutrition with dehydration, use special ORS or classic ORS diluted to half-strength with added sugar (25 g/liter) and potassium (2 g/liter)
    b) **Infection**: respiratory, urinary tract, measles, gastrointestinal, parasitic, skin, septicemia
    c) **Hypothermia** -- keep children warm, especially in the night and early morning when ambient temperature may drop
    d) **Hypoglycemia** – regular feeding during day and night
    e) **Cardiac failure** – can result from electrolyte disturbances, fluid overload, or severe anemia
    f) **Severe anemia** – folic acid and iron supplementation
6. Micronutrient supplements encouraged
7. **Nutritional therapy: phase 1** (24 hour intensive care)
    a) Maximum 7 days
    b) Energy 100 kcal/kg/day, protein up to 1-1.5 gm/kg/day
    c) Use high energy milk (HEM), 1 kcal/ml; give 100 ml/kg/day (100 kcal, 2.9 gm protein/kg/day)

	Grams per liter	Protein (gm)	Kcal
Dried skim milk	80	28.8	285
Vegetable oil	60		530
Sugar	50		200
Total*	1 liter	28.8	1,015

{*water is added to the dry ingredients to make one liter of HEM (approximately 900 mls)}
Sample composition of **High Energy Milk (HEM)** for therapeutic feeding (from Medecins Sans Frontieres. *Nutritional Guidelines.* 1995.)

d) Frequent, small feeds: day 1-2: 12 feeds of 8 ml/kg q 2 hrs;
Day 3-7: 8 feeds of 12-15 ml/kg q 3 hrs

e) Indications for nasogastric feedings (try oral feeds before each NG feed; limit to 3 – 4 days maximum) Note: Necessity must be explained to mother for cultural acceptance so child is not removed from program

1) Complete anorexia
2) Severe dehydration
3) Child too weak to drink
4) Repeated vomiting

f) Potassium supplementation: 2 g KCl per 1000 ml HEM or bananas

g) Transfer to phase 2

1) Medical complications under control
2) Recovery of appetite
3) Change of attitude/expression (loss of lethargy)

8. **Nutritional rehabilitation: phase 2** (day care)

a) Goal: restore normal weight for height as quickly as possible with weight gain up to 20 g/kg/day

b) Intake: minimum 200 kcal/kg/day; 3-5 g protein/kg/day (10% of kcals from protein)
Maximum 300 kcal/kg/day on demand

c) Small stomach capacity limits volume of feeds, requiring smaller, frequent feeds

d) Composition: HEM or HEM alternating with porridge feeds; eventually, local foods replace porridge and transition is to family-type diet and meal frequency (Table 7)

Time	Meal
0800	HEM + banana
1000	HEM
1200	Porridge
1400	HEM
1600	Porridge
1700	Return home with package of biscuits

Example of a meal schedule in day-care: phase 2 TFP (from Medecins Sans Frontieres. *Nutritional Guidelines.* 1995.)

e) Continue medical monitoring

f) Vitamins and minerals

1) ferrous sulfate 100 mg/day from day 15 (risk of free radical formation, bacterial growth, infection promotion earlier)

2) folic acid 5 mg/day

3) fresh fruit and vegetables or MVI + vitamin C 125 mg/day

g) Psychosocial stimulation

9. Anticipated results: 10-20 gm/kg/day weight gain during phase 2. Discharge to a supplemental feeding program when they have maintained 80% W/H for at least 2 weeks, with no edema or severe medical problems.

E. **Supplementary feeding programs**

1. Moderate acute malnutrition (70-79% W/H, -2 Z scores)

2. Goal: supplement or address a deficient family diet and allow for catch-up growth

a) Target amounts around 500-700 kcals/day, 15-25 gm protein/day (10-15% of kcals as protein based on assumption that diet is otherwise low in protein)

b) Provide excess amounts of take-home rations for other family members (double or triple quantity)

c) Ration composition: balanced, high concentration of energy and protein, 1 kcal/ml, 10-15% of kcals as protein

3. Two forms: wet vs. dry rations

a) **Wet rations** are prepared/cooked on-site in a feeding center once or twice daily and are usually consumed on-site.

1) Ensures that the target individual consumes the supplement

2) Allows provision of complementary health care services on-site

3) Participants do not need firewood supply or cooking utensils

4) Provides security advantage if it is feared that women carrying dry rations will be robbed on their way home

b) **Dry rations** are distributed (usually weekly) for off-site preparation and consumption.

1) Lower cost, fewer staff resources needed

2) Reach larger numbers; larger amounts required

3) Families remain in homes

4) Lower transmission of communicable diseases

5) Mother has less time cost for participation, maintains feeding responsibility

4. **Medical care in SFP's**: public health preventative and curative measures

a) Treatment of infections

b) Treatment of diarrhea and dehydration

c) Treatment of specific vitamin and mineral deficiencies

d) Update immunizations

e) Routine therapy and prophylaxis

1) Measles immunization

2) Prophylactic dose of 200,000 IU vitamin A

3) Mebendazole on admission for children > 1 year

4) Vitamin C 125 mg/day if scurvy prevalent and no fresh fruit and vegetables provided

5) Chloroquine prophylaxis if indicated

5. Anticipated results: 5-10 g/kg/day weight gain, achieving 85% W/H in 4-6 weeks, with discharge after 6-10 weeks, when child has maintained W/H>85% for one month.

F. **Monitoring of feeding programs**

1. Record the weight gain of individual children
2. Assessment of effectiveness
   a) Regularity of attendance
   b) Proportion of population of malnourished children who are included in the program (coverage)
   c) Number of deaths
   d) Access to feeding centers or distribution points

G. Criteria for **closing a feeding program**

1. General food distributions are reliable and adequate
2. Effective public health and disease control measures are in place
3. No seasonal deterioration of nutritional status is anticipated
4. Mortality rate is low
5. The population is stable
6. An adequate level of security is in place

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TABLE 7: Recipes for porridge for use in therapeutic and wet supplementary feeding programs.

E. Recipe One: Maize flour + Dried skim milk (DSM) based porridge

ITEM	Weight (g)	Kcal	Protein (g)
MAIZE	60	215	6
DSM	45	160	16
OIL	30	265	0
SUGAR	15	60	0
WATER	±400	0	0
TOTAL	550	700	22

F. Recipe Two: Corn soya blend (CSB) based porridge

ITEM	Weight (g)	Kcal	Protein (g)
CSB	100	380	18
OIL	30	265	0
SUGAR	20	80	0
WATER	±300	0	0
TOTAL	450	725	18

The porridge can be prepared for children in Therapeutic feeding as well for children in wet Supplementary feeding centers.
Usually, a porridge will provide ~ 150 Kcal/100 ml and ~ 4 grams of protein/100 ml

Preparation:
Always prepare a sample and taste the porridge before distribution. The porridge should be semi-liquid.
Generally the preparation is:

Add 1 volume of premix to 2-3 volumes of water
Boil for 10-15 minutes

Cooked porridge should not be kept for more than 2 hours.

(from Medecins Sans Frontieres. *Nutritional Guidelines.* 1995)